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(54) Method for manufacturing agglomerates of sintered pellets.

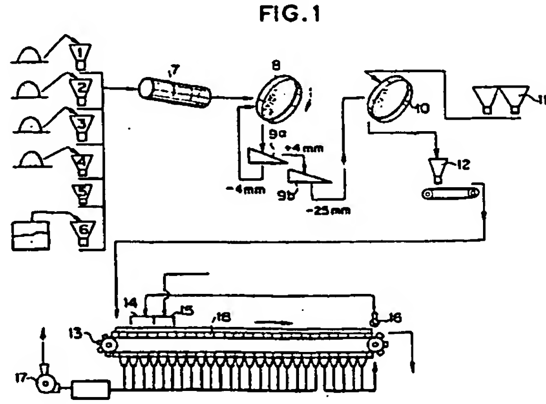
(57) A method for manufacturing agglomerates of sintered pellets comprises the steps of mixing and pelletizing fine iron ore, flux, binder and return fines, coating pelletized materials, charging the green pellets into a sintering machine (13), drying charged green pellets in a drying furnace (14) and igniting the pellets in an ignition furnace (15), sintering the green pellets in the sintering machine, and measuring a noise level by the use of a noise sensor arranged on a sintering bed and controlling a sintering operation on the basis of the noise level.

The noise level during igniting of the green pellets is measured by the use of a noise sensor (20) arranged on an ignition furnace and permeability of the green pellets are controlled on the basis of the noise level.

The noise level is measured by the use of plurality of noise sensors (30a, 30b, 30c, 30d) arranged in the longitudinal direction of thesintering machine followed by the ignition furnace and the burn through point is controlled on the basis of the noise level.

The noise level is measured by the use of plurality of noise sensors (40) arranged in the direction of a width of apallet following the ignitition furnace and densities of charged materials are controlled on the basis of the measured values.

FIG.1



EP 0 383 079 A2

METHOD FOR MANUFACTURING AGGLOMERATES OF SINTERED PELLETS

The present invention relates to a method for manufacturing agglomerates of sintered pellets, and more particularly to a method for controlling operations in manufacture of agglomerates of sintered pellets by the use of sensors.

Fine iron ore, flux such as serpentine and return fines are blended and mixed by a mixer, and a mixture thereof is pelletized by a primary pelletizer. Pelletized materials made by the primary pelletizer are coated with a solid fuel and green pellets of 5 to 10 mm in particle size are manufactured. Said green pellets are charged into a grate type sintering machine and sintered. Sintered pellets are crushed into particles of predetermined size. Then, they are cooled and classified whereby agglomerates of 4mm or more in size are manufactured.

The following control is carried out during manufacture of agglomerates of sintered pellets.

(a) A worsening of permeability of green pellets charged into a sintering machine is found through a fall of temperatures of a plurality of wind boxes on a discharge side of agglomerates and a rise of suction pressure of a main blower. Moreover, positions of a burn through point are controlled. The positions of the burn through point are determined by measuring wind box temperatures of the sintering machine and finding positions of the wind boxes having the highest temperature from a distribution of the wind box temperatures. A pallet speed is controlled so that the positions of the burn through point can be optimum positions.

(b) A difference in the wind box temperatures in a direction of a width of the wind box or a difference in a high temperature zone of an agglomerate discharge portion in a direction of a width of the layers are estimated. Densities of charged green pellets in a direction of a width of the sintering machine are controlled to make uniform a sintering speed in a direction of the width of the sintering machine on the basis of estimated differences in the direction of said widths.

In the above-mentioned method (a), the worsening of permeability of the pellets can be found only 30 to 35 minutes later after pellets of bad permeabiltiy charged into the sintering machine have passed an ignition furnace. Moreover, the reason for the worsening of the permeability is not understood if it is caused by a bursting of the green pellets or the other reasons. Since it takes much time to understand the reason for the worsening of the permeability, there occur a decrease of a productivity and lowering of quality of products.

In the case of using the difference in the wind box temperatures in the above-mentioned (b), there occur errors due to an air leakage. Therefore, only when a portion where the sintering speed is ununiform reaches the wind box on the side of the agglomerate discharge portion, the difference in the wind box temperatures in the direction of the width thereof can be detected. The difference in the high temperature zone in the direction of the width thereof can be detected only when a portion of abnormal sintering reaches the agglomerate dischrage portion. That is, only 30 to 40 minutes later after the charge of the green pellets into the sintering machine, occurrence of the portion of abnormal sintering can be detected. Due to delay of a detection of the abonormal sintering, a control of the densities of the charged pellets in the direction of the width of the sintering machine delays. Accordingly, there are problems such that the productivity and the yield of agglomerates of sintered pellets lower.

It is an object of the present invention to improve a productivity, a yield and quality of agglomerates of sintered pellets.

To accomplish the above-mentioned object, the present invention provides a method for manufacturing agglomerates of sintered pellets comprising the steps of:

mixing and pelletizing fine iron ore, flux, binder and return fines;

coating pelletized materials obtained at the step of said mixing and pelletizing with powdery solid fuel, green pellets coated with powdery solid fuel being produced; charging said green pellets into a sintering machine;

drying charged green pellets in a drying furnace and igniting said pellets in an ignition furnace;

sintering said green pellets in said sintering machine; and

measuring a noise level by the use of a noise sensor arranged above a sintering bed and controlling a sintering operation on the basis of said noise level.

The above objects and other objects and advantages of the present invention will become apparent from the detailed description which follows, taken in conjunction with the appended drawings.

Fig.1 is an explanatory view illustrating the steps from bins to a sintering machine;

Fig.2 is a block diagram showing a control of a sintering operation by the use of a noise sensor arranged on an ignition furnace of the present invention;

Fig.3 is a block diagram showing a control of a sintering operation by the use of noise sensors arranged in the longitudinal direction of the sintering machine of the present invention;

Fig.4 is a graphical representation showing a control of positions of a burn through point of the present invention;

Fig.5 is a schematic illustration indicating a method for detecting positions of a combustion zone in a direction of a width of a pallet of the sintering machine of the present invention;

Fig.6 is a schematic illustraiton designating a material charge portion of the sintering machine used for execution of the method of the present invention; and

Fig.7 is a schematic illustration showing a method for controlling densities of materials charged into the sintering machine of the present invention.

Preferred Embodiment-1

Green pellets are rapidly heated during drying and on the occasion of igniting. When iron ore liable to be broken by heat is included into the green pellets, the green pellets burst and convert to powder due to a heat break of the iron ore and evaporation of water in the green pellets. When the green pellets often burst, permeability of a sintering bed worsens. The number of burstings of the green pellets are connected with a sound of burstings. The sound of burstings is measured above the sintering bed. The number of burstings of the green pellets passing through the ignition furnace are detected by a sensor positioned on the ignition furnace as a level of noises. That is, since the worsening of permeability of the green pellets due to the bursting of the green pellets is detected at a moment when the green pellets pass through the ignition furnace, a prompt operation action can be taken.

Fig.1 is an explanatory view illustrating the steps from a bin to a sintering machine. Coarse particle iron ore in bins 1 and 2, fine pellet feed in bin 3, serpentine as flux in bin 4, return fines of less than 4 mm in particle size in bin 5 and burnt lime as a binder in bin 6 are cut in a predetermined quantity. Water is added to them. And they are mixed. Return fines are produced during crushing and classifying of agglomerates of sintered pellets. A mixture obtained by mixing the above-mentioned materials is primarily pelletized by the use of a primary disk pelletizer 8, water being added to the mixture. Primary agglomerates pelletized by the primary disk pelletizer 8 are sieved with screen 9a of 4 mm in mesh. The agglomerates of less than 4 mm in particle size having been sieved are returned to the primary disk pelletizer 8 and repeatedly pelletized. The agglomerates of 4 mm or more in particle size are sieved with screen 9b of 25 mm in mesh. Agglomerates of less than 25 mm in particle size are charged into secondary disk pelletizer 10. Solid fuel in bin 11 is added to the secondary disk pelletizer and primary agglomerates are coated with the solid fuel whereby green pellets of 5 to 10 mm in particle size are manufactured. Powdery coak, char, pulverized coal or the like is used as the solid fuel.

Obtained green pellets are charged into pallet 18 of grate type sintering machine 13 through primary hopper 12. The green pellets are charged into the pallet 18 by means of a belt conveyer (not shown). Charged green pellets are cut off to be a predetermined uniform height. After the green pellets having a predetermined uniform height have been dried in the drying furnace 14, the surface of the green pellets is ignited in ignition furnace 15. High-temperature exhaust gas out of the wind box on the side of the agglomerate discharge portion of the sintering machine is used in the drying furnace 14. Said high-temperature exhaust gas is sent to the drying furnace 14 by means of circulation fan 16. In the sintering machine following the drying furnace 14, gas or air is sucked downward by main blower 17 through the surface of the green pellets charged into the pallet 18. A combustion zone produced on the surface of green pellets layer moves downward with movement of the pallet. The green pellets layer is sintered in the whole height of the layer just before the agglomerates discharge portion of the sintering machine and discharged continuously from the agglomerates discharge portion. Discharged agglomerates are sent to crushing and classifying steps.

Fig.2 is a block diagram showing a control of a sintering operation by the use of a noise sensor arranged on an ignition furnace of the present invention. Noise sensor 20 are mounted on the ignition furnace 15. Levels of noises generated on the occasion of igniting the green pellets are detected by the noise sensor 20. The sintering operation is controlled on the basis of the levels of nosises. The sintering operation is controlled by an amount of binder added to agglomerates at the steps of mixing and pelletizing and temperatures in the drying furnace and in the ignition furnace. When a noise level exceeds a predetermined value, at least one action selected from the group of an increase of the amount of added binder, a rise of temperatures in the drying furnace 14 and a fall of temperatures in the ignition furnace 15 is taken.

The noise sensor 20 is mounted on a sound tube penetrated into a wall of the ignition furnace. The noise sensor can be positioned in a void portion, through which noises inside the ignition furnace escape. A signal of measured value obtained by measurement of noises with the use of the noise sensor 20 is sent to processing unit 21. Predetermined noise level values, action order and

action amount which carry out the operation action are inputted into the processing unit 21. To take action or not and what action to take are decided on the basis of the measured value. When a noise exceeds a predetermined noise level, for example, firstly, the amount of added burnt lime is increased. When the noise level does not lower for a predetermined period of time after burnt lime has been added, an action to raise the temperatures inside the drying furnace is taken. When the noise level does not lower even though the above-mentioned actions are taken, an action to lower the temperatures inside the ignition furnace is taken. The amount of added burnt lime is controlled by controller 22, the temperatures inside the drying furnace by controller 23 and the temperatures inside the ignition furnace by controller 22.

In Preferred Embodiment-1, the operation action can be taken by 1 to 2 hours earlier than in the prior art method. In consequence, the productivity and quality of products can be prevented from lowering.

Preferred Embodiment-2

Preferred Embodiment-2 will be described with specific reference to the appended drawings. Fig.3 is a block diagram indicating a control of a sintering operation by the use of noise sensors arranged in the longitudinal direction of a sintering machine of the present invention. Green pellets manufactured in such a manner as shown in Fig.1 are charged into pallet 18 of a grate type sintering machine 13. After the green pellets charged into the pallet 18 have been dried in drying furnace 14, the surface of the green pellets are ignited by ignition furnace 15. In a sintering machine following the drying furnace 14, gas or air is sucked downward by a main blower through the surface of a layer of the green pellets charged into the pallet 18. A combustion zone produced on the surface of the layer of the green pellets moves downdard with movement of the pallet. The green pellets layer is sintered in the direction of a height of the green pellets layer just before an agglomerates discharge portion of the sintering machine and discharged continuously from the agglomerates discharge portion. Discharged agglomerates are sent to crushing and classiffying steps.

Green pellets containing iron ore liable to be broken by heat burst due to a break of the iron ore by heat and evaporation of water contained in the green pellets and produce a bursting sound. When a noise level of the bursting sound is measured above a sintering bed, it is understood that the noise level lowers with the movement of the combustion zone downward along the green pellets layer. Since the bursting sound of the green pellets has a specific frequency zone, accuracy of measurement of the bursting sound is enhanced when the noise level is measured by means of a band pass filter of this zone.

A plurality of noise sensors 30a, 30b, 30c and 30d are arranged at an equal interval on the upper side of a sintering bed following the ignition furnace in the longitudinal direction of the sintering machine. Said interval is desired to be about 2 m. The noise sensors are positioned 5 to 10 cm above a sintering bed. A signal of the noise level measured by the noise sensors 30a, 30b, 30c and 30d is sent to arithmetic and control unit 32. A damping straight line of the noise level can be found by representing positions of the noise sensors 30a, 30b, 30c and 30d in the longitudianl direction of the sintering machine with the axis of abscissa and the noise level with the axis of ordinate and by making an approximate straight line. A burn through point can be found by a point of intersection where a straight line indicating the predetermined noise level No at the burn through point, namely, y = No crosses said damping straight line. Fig.4 is a graphical representation showing a method for controlling positions of the burn thorugh point of the present invention. When a found damping straight line of the noise level is B as shown in Fig. 4, distance D_4 can be obtained from a point of intersection where said damping straight line crosses a straight line indicating the noise level No at the burn through point, namely y = No. The distance D_4 is the burn through point and is represented with a distance from an rear end of the ignition furnace. It is confirmed where D_4 is relative to a range of an optimum burn through point. In case the burn through point is in the position of the distance D_4, since the burn through point is positioned on the side of the agglomerates discharge portion rather than the optimum range of D_1 to D_2, a signal to decrease a predetermined pallet speed is outputted.

In case a found damping straight line of the noise level is A as shown in Fig.4, distance D_5 is obtained from a point of intersection where the damping straight line A crosses a straight line indicating noise level No at the burn through point, namely, y = No. Distance D_5 is the burn through point and is represented with distance from a rear end of the ignition furnace. In case the burn through point is positioned at D_5, since the burn through point is in the optimum range of D_1 to D_2, signals of increase and decrease of the pallet speed are not outputted.

When a found damping straight line of the noise level is C as shown in Fig. 4, the distance of the burn through point is D_3. Since D_3 is positioned on the side of the ignition furnace rather than in the

optimum range of D_1 to D_2, signals to increase a pallet speed to a predetermined speed are outputted.

The pallet speed is increased and decreased as follows:

(a) A relational expression of a position of the burn through point relative to the increase or decrease of the pallet speed is found in advance.

(b) An amount of movement of the burn through poit is found so that the burn through point can be in the range of D_1 to D_2.

(c) The increase and decrease of the pallet speed is found by putting the amount of movement of the burn through point into the above-mentioned expression.

Signals of the increase and decrease of the pallet speed which are found in such a way as described above are sent to drive motor 34 of the sintering machine by means of artithmetic and control unit 32. The pallet speed is increased or decreased by the drive motor 34. Accordingly, the burn through point is always controlled so that it can be within the optimum range.

Noise sensors 30a, 30b, 30c and 30d are desired to be arranged 5 to 10 m from the rear end of the ignition furnace on the side of the agglomerates discharge portion. The burn through point can be detected by 15 to 20 minutes earlier than in the prior art method by arranging the noise sensors 5 to 10 m from the rear end of te ignition furnace. Accordingly, since the burn through point can be detected early and actions can be taken early, worsening of quality of products and a fall of quantity of production can be prevented.

Preferred Embodiment-3

Fig.5 is a schematic illustration showing a method for detecting positions of a combustion zone in a direction of a width of a pallet of a sintering machine of the present invention. The surface of the green pellets charged into the sintering machine is ignited in the ignition furnace 15. The combustion zone produced by ignition is moved downward in a layer of green pellets by a downward suction of gas or air as the pallet 18 moves to the side of the agglomerates discharge portion. When there is a deviation of suction of air in the direction of the width of the pallet, a deviation of a speed of a downward movement of the combustion zone takes place. As clearly seen from a section of a sintering bed, there occurs a deviation of heights of the layer from the surface of the sintering bed to the combustion zone 37. In an example of Fig.5, the height of a central portion in the direction of the width of the pallet is smaller than the height of a portion near side walls of the pallet when the height of the central poriton is compared with that of the poriton near side walls of the pallet. Sinter zone 36 is present in an upper portion of the combustion zone 37. Zone 38 of green pellets is present in a lower portion of the combustion zone 37. The sinter zone 36 and the zone 38 of green pellets are deviated corresponding to the deviation of the combustion zone37.

Some of the green pellets burst in the combustion zone 37 and produce a bursting sound. A noise level of the bursting sound is measured by a noise sensor arranged on an upper surface of the sintering bed. Since the noise level damps in proportion to a depth of the combustion zone 37, positions of the combustion zone 37 in the direction of the width of the pallet can be caught when sensors are arranged at a plurality of positions in the direction of the width of the pallet.

Every five noise sensors 40 are arranged at a definite interval in the direction of the width of the pallet 45 in two rows 5 to 10 cm over the surface of the sintering bed. A distance from the noise sensor 40 to an end of the discharge side of the ignition furnace is desired to be a distance, in which a deviation of the depth of the combustion zone in the direction of the width thereof can be clearly caught. Since the bursting sound of the green pellets has a specific frequency zone, accuracy of measurement of the bursting sound is enhanced when the noise level is measured by means of a band pass filter of the specific frequency zone. For example, a frequency zone of 250 to 570 Hz is used. Signals of measurement of the noise sensor 40 are subjected to data processing by means of processing unit 42. Data having been subjected to graphic processing or display processing are represented as graphs or tables on CRT 44.

Fig.6 is a schematic illustration showing a material charging portion of a sintering machine used for executing the method of the present invention. Green pellets are charged into pallet 18 by the use of charging belt conveyer 46. A height of charged green pellets is made uniform to have a predetermined height by the use of cut plate 48.

Fig.7 is a schematic illustration showing a method for controlling densities of materials charged into a sintering machine. The densities of the materials are controlled by a height of layers of the green pellets stacked up near side walls of the pallet. An amount of the green pellets of large particle size flowing into the center of the pallet is controlled by controlling the height of the layers of green pellets. When there is a great amount of green pellets of large particle size flowing into the center of the pallet, permeability of the green pellets at the center of the pallet becomes better. Conversely, when there is a small amount of green pellets of large particle size flowing into the center

of the pallet, permeability of the green pellets of large particle size becomes worse. The amount of green pellets of large particle size flowing into the center of the pallet is controlled by means of dispersing plate 50 arranged on the charging belt conveyer 46. That is, vertical angle 52 of the dispersing plate is controlled on the basis of a depth of layers of green pellets in the combustion zone 37, which is caught by the noise sensor 40, in the direction of the width of the pallet. In case positions of the combustion zone near the side walls of the pallet are deep, the densities of the materials charged into the pallet is increased by making the vertical angle of the dispersing plate 50 wide to a predetermined angle. When the densities of charged materials are increased, a sintering speed decreases. In consequence, there is no lack of heat near the side walls of the pallet and this prevents the pellets from being not sintered.

According to the present invention, densities of materials charged into a pallet in the direction of a width of the pallet can be controlled 25 to 30 minutes earlier than in the prior art method. Accordingly, since action can be taken promptly, a decrease of the yield and the productivity of agglomerates of sintered pellets can be prevented.

Claims

1. A method for manufacturing agglomerates of sintered pellets comprising the steps of:
mixing and pelletizing fine iron ore, flux, binder and return fines;
coating pelletized materials obtained at the step of said mixing and pelletizing with powdery solid fuel, green pellets coated with powdery and fuel being produced;
charging said green pellets into a sintering machine (13);
drying charged green pellets in a drying furnace (14) and igniting said green pellets in an ignition furnace (15); and
sintering said green pellets in said sintering machine;
characterized by measuring a noise level by the use of a noise sensor arranged above a sintering bed and controlling a sintering operation on the basis of said noise level.

2. The method of claim 1, characterized in that said controlling a sintering operation includes measuring a noise during igniting of the green pellets by the use of a noise sensor (20) arranged at the ignition furnace and controlling the sintering operation on the basis of the noise level.

3. The method of claim 2, characterized in that said sensor is mounted on a sound tube penetrated into a wall of the ignition furnace.

4. The method of claim 2, characterized in that said sintering operation is controlled by an amount of binder at the steps of mixing and pelletizing.

5. The method of claim 2, characterized in that said sintering operation is controlled by a temperature in a drying furnace.

6. The method of claim 2, charaterized in that said sintering operation is controlled by a temperature in an ignition furnace.

7. The method of claim 1, characterized in that said controlling a sintering operation includes measuring a noise level by the use of a plurality of noise sensors (30a, 30b, 30c, 30d) arranged in the direction of a sintering machine following the ignition furnace and controlling a burn through point on the basis of said noise level.

8. The method of claim 7, characterized in that said burn through point is controlled by means of a pallet speed.

9. The method of claim 7, characterized in that said plurality of sensors are sensors positioned 5 to 10 m from a rear end of the ignition furnace to the side of an agglomerates dischrage portion.

10. The method of claim 7, characterized in that said noise sensors are positioned 5 to 10 cm above a surface of a sintering bed.

11. The method of claim 7, characterized in that said noise level is measured in a frequency zone of 250 to 570 Hz.

12. The method of claim 1, characterized in that said controlling a sintering operation comprises;
measuring the noise level by the use of plurality of sensors (40) arranged in the direction of a width of the pallet following the ignition furnace;
finding a deviation of measured noise level; and
controlling densities of charged materials in the direction of a width of the sintering machine on the basis of the found deviation.

13. The mthod of claim 12, characterized in that said noise sensor is arranged 5 to 10 cm above the surface of the sintering bed.

14. The method of claim 12, characterized in that said noise level is measured in the frequency zone of 250 to 570 Hz.

15. The method of claim 12, characterized in that said controlling densities of charged materials is carried out by means of a dispersing plate (50) arranged on a charging belt conveyer (46) for charging green pellets into the sintering machine.

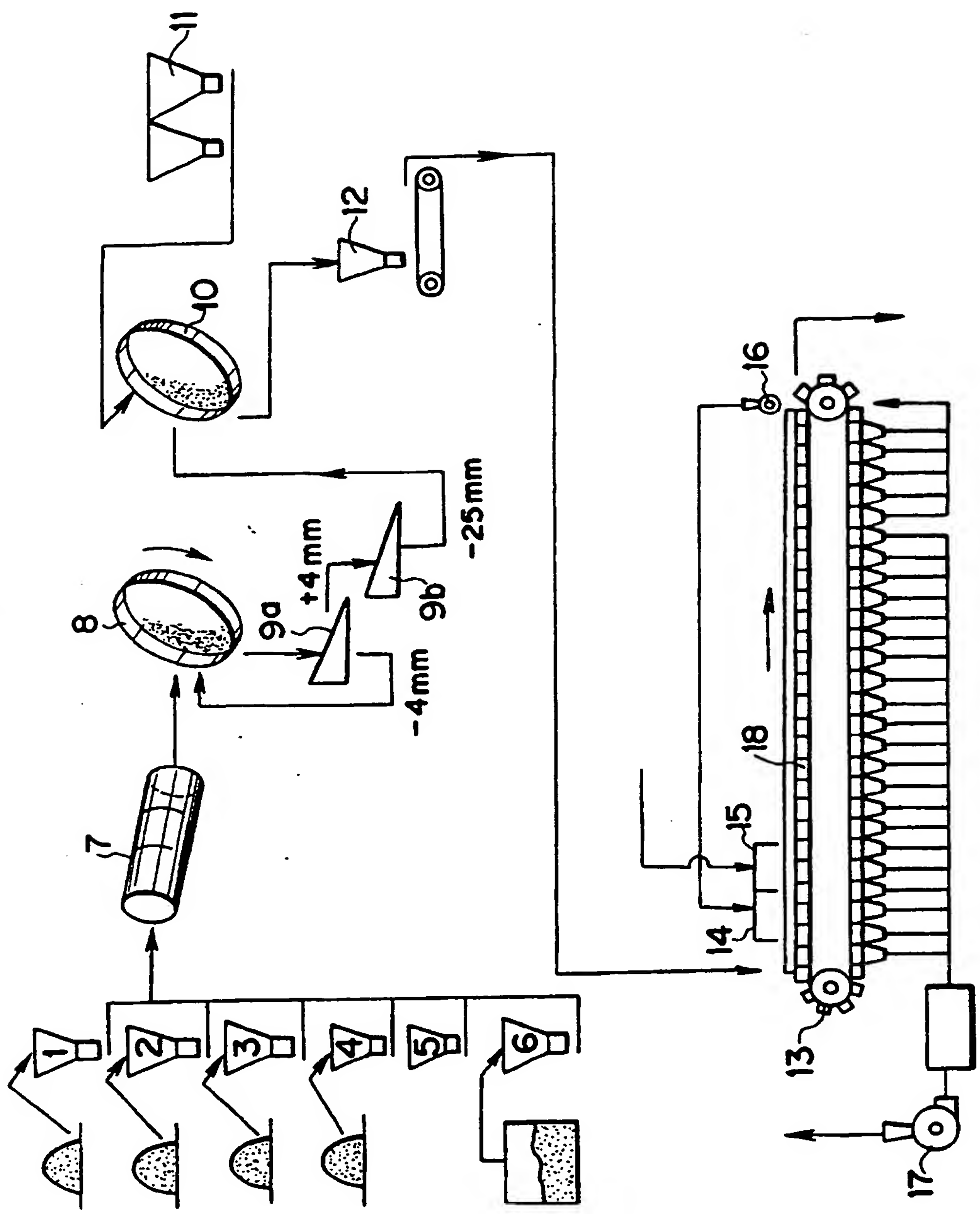


FIG. 1

FIG.2

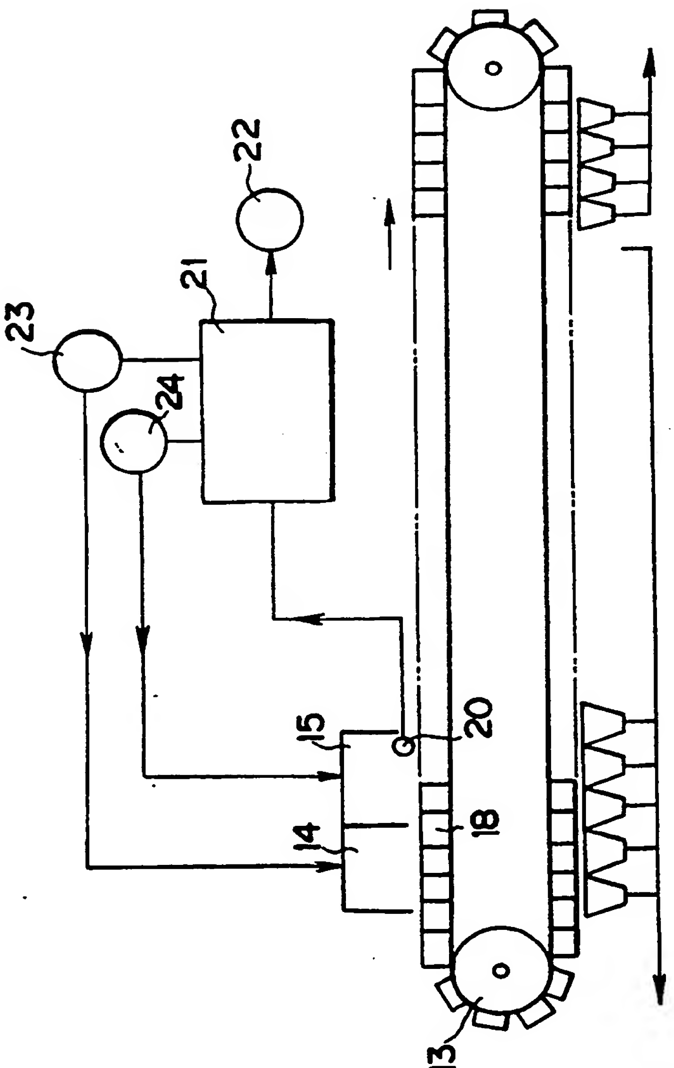


FIG.3

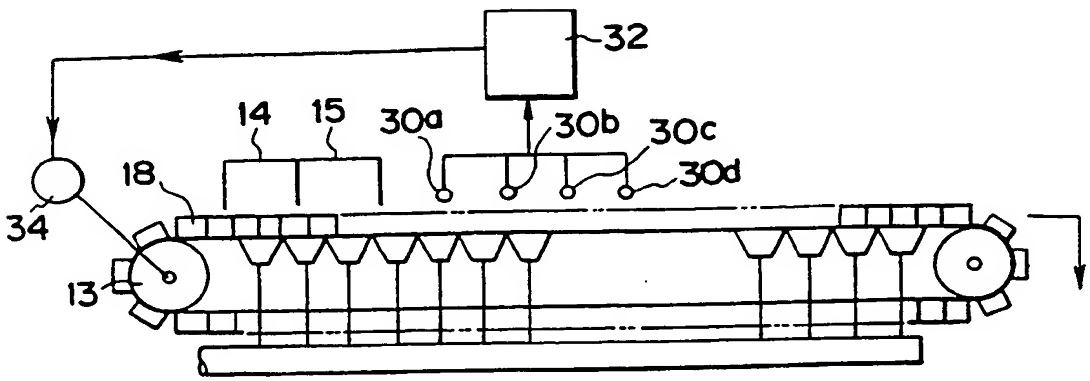

32
14
15
30a
30b
30c
30d
18
34
13

FIG.4

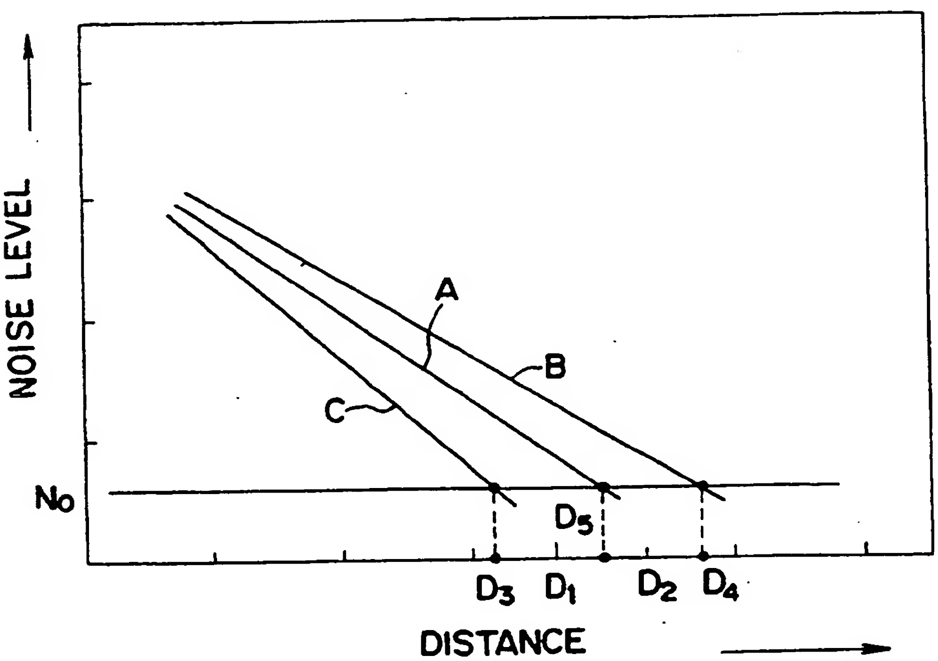

NOISE LEVEL
A
B
C
No
D5
D3
D1
D2
D4
DISTANCE

FIG.5

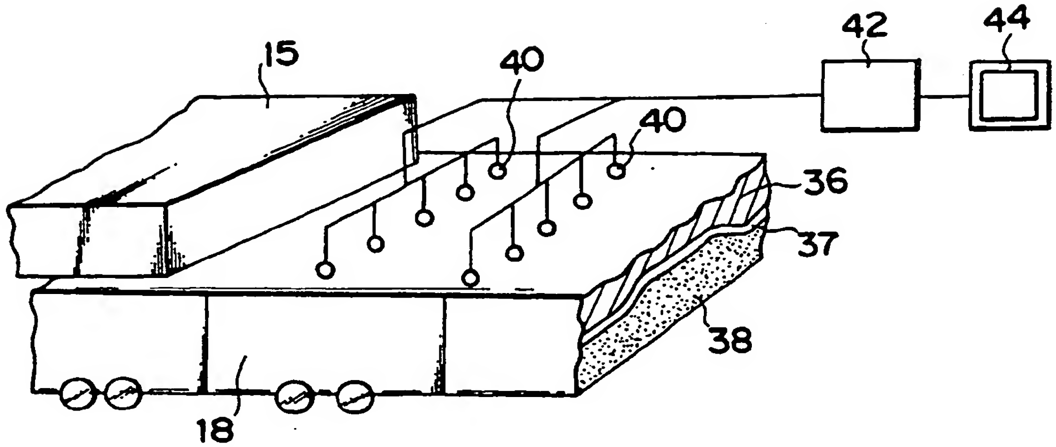


FIG.6

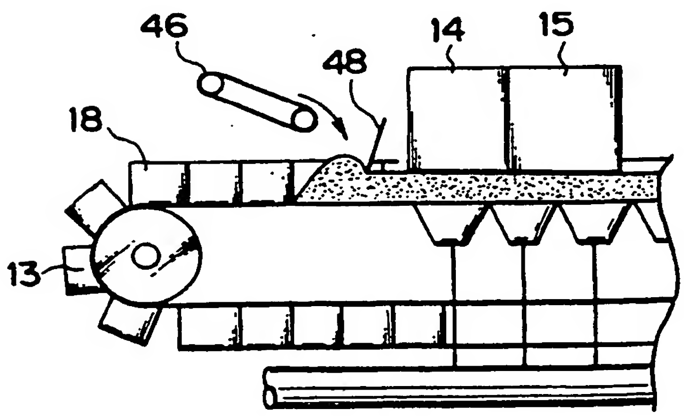
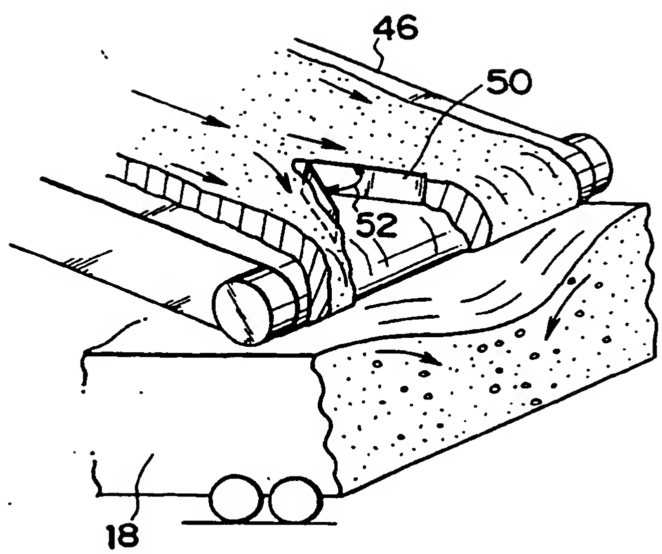


FIG. 7



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The noise level during igniting of the green pellets is measured by the use of a noise sensor (20) arranged on an ignition furnace and permeability of the green pellets are controlled on the basis of the noise level.

The noise level is measured by the use of plurality of noise sensors (30a, 30b, 30c, 30d) arranged in the longitudinal direction of thesintering machine followed by the ignition furnace and the burn through point is controlled on the basis of the noise level.

The noise level is measured by the use of plurality of noise sensors (40) arranged in the direction of a width of apallet following the ignitition furnace and densities of charged materials are controlled on the basis of the measured values.

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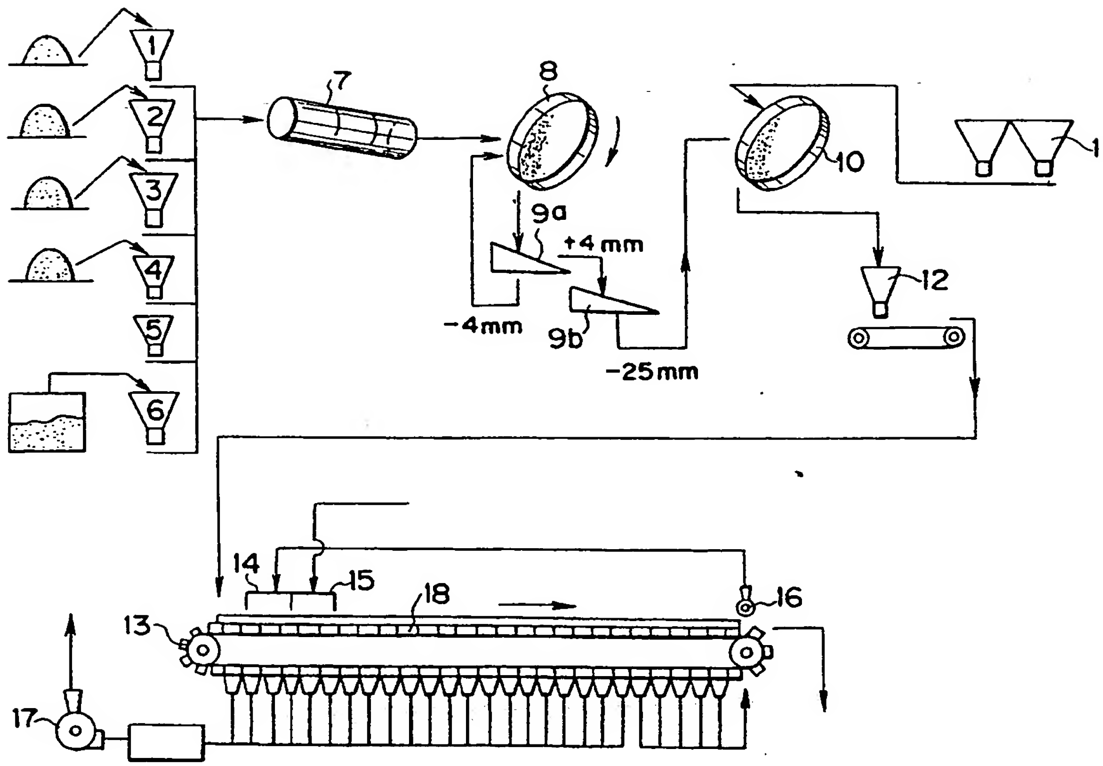
FIG. 1



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EUROPEAN SEARCH REPORT

Application Number

EP 90 10 1622

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	REVUE DE METALLURGIE, vol. 77, nos. 8-9, August-September 1980, pages 665-674, Paris, FR; A. DIDIER et al.: "Addition de chaux à l'agglomération sur grille" * Pages 671-672 *	1,4	C 22 B 1/20 F 27 B 21/06
A	REVUE DE METALLURGIE, vol. 73, no. 3, March 1976, pages 177-200, Paris, FR; J. BLONDEAU et al.: "Récents développements de l'agglomération sur grille en France" * Pages 194-197 *	7-9	
A	DE-B-2 120 799 (FRIED. KRUPP) * Claims 1,2; figures *	1	
A	DE-B-1 182 271 (CNRM, BRÜSSEL) * Claims *	1	
A	EP-A-0 104 747 (BRITISH STEEL CORP.) * Page 1 *	1	
A	PATENT ABSTRACTS OF JAPAN, vol. 9, no. 36 (C-266)[1759], 15th February 1985; & JP-A-59 179 721 (KAWASAKI SEITETSU) 12-10-1984 * Figure; abstract *	12	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	PATENT ABSTRACTS OF JAPAN, vol. 10, no. 345 (C-386)[2401], 20th November 1986; & JP-A-61 147 820 (SUMITOMO METAL) 05-07-1986 * Figures; abstract *	7,12	C 22 B F 27 B F 27 D C 21 C
A	DE-A-3 041 95 (VOEST ALPINE AG) * Claims; figures *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	04 December 90	BOMBEKE M.J.P.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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&: member of the same patent family, corresponding document